

Quantum Phenomena at Interfaces and Surfaces

Cui-Zu Chang

Department of Physics, Pennsylvania State University

In this talk, I will highlight the exciting physics at the interfaces/surfaces of quantum materials and then introduce my research on two solid-state phenomena with zero resistance: the quantum anomalous Hall (QAH) effect and the interface superconductivity. The QAH insulator, a material exhibiting insulating properties in its interior while allowing electrons to travel with zero resistance along one-dimensional conducting edge channels, serves as an outstanding platform for energy-efficient electronics, spintronics, and topological quantum computations. I will first talk about our recent progress on the electrical switching of the edge states chirality in QAH insulators and three-dimensional QAH and axion insulators with a thickness of a hundred nanometers. I will also talk about our recent discovery of interfacial superconductivity in MBE-grown QAH/iron chalcogenide heterostructures. The QAH/iron chalcogenide heterostructures fulfill the two essential ingredients of the long sought-after chiral topological superconductivity, which provide an alternative platform for the exploration of Majorana physics towards topological quantum computations.

Dr. Cui-Zu Chang is a Henry W. Knerr Associate Professor in the Department of Physics at The Pennsylvania State University. Chang received his bachelor's degree in 2007 from Shandong University and Ph.D. in 2013 from Tsinghua University. Prior to joining Penn State, Dr. Chang conducted postdoctoral research at MIT for four years. Dr. Chang's research primarily focuses on topological insulators (TIs), QAH insulators, and their integration of superconductors, with the long-term goal of employing these platforms for scalable quantum information science and dissipationless quantum devices. His awards include NSF CAREER Award (2019), ARO-Young Investigator Program Award (2018), Alfred P. Sloan Research Fellowship (2018), IUPAP Young Scientist Prize (2016), Macronix Prize (2019), Gordon and Betty Moore EPiQS Materials Synthesis Investigator Award (2019), Henry W. Knerr Early Career Chair Professor (2021), and Rustum and Della Roy Innovation in Materials Research Award (2021).